JPRS: 4049

20 September 1960

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COAL MINING TECHNOLOGY IN COMMUNIST CHINA

[The following are translations of selected items from the Chinese-language periodical Mei-k'uang Chi-shu (Coal Mining Techniques), a semi-monthly published in Peiping, Number 9, dated 1 May 1960.]

CONTENTS

COAL MINE TURNS OUT OVER 60,000 METRIC TONS OF COAL MONTHLY BY HYDRAULIC MINING

[The following is a translation of extracts from an article by the Tang-chia-chuang Mine in K'ai-luan, Mei-k'uang Chi-shu, Peiping, No. 9, 1960, pp 4-5.]

All the staff members and workers in the Third Hydraulic Mining District of the Tang-chia-chuang Mine, raising high the red flag of Mao Tse-tung's ideology and the general line, plunging deeply into a red-flag competition of large area high production, promoting a production movement, encouraging technical reform and technical revolution, attacking production difficulties, and climbing up with great effort to a technical peak, have created a new national record by producing 64,000 metric tons of coal from 2,276 working faces, in the month of April. The production rate per working face is 17.28 metric tons/worker, and timber consumption is only 1.39 cubic meters/1,000 tons. They have fulfilled their economic goals.

I. Introduction

1. Geological Factors of the Mining District:

The length of the deposit is 600 meters, the length of its slope 570 meters. The slope of the coal deposit has an inclination of 10°-16°. Its thickness is from 2.5-3.5 meters. There are two strata of slate running through the deposit. The upper layer is close to the roof, with a thickness of 1-0.2 meter, while the lower layer is close to the floor at a distance of 0.8-1.0 meter, with the thickness of 0.4-0.8 meter. The direct roof is a stratum of gray sandstone and the

direct floor is a stratum of black rock.

The coal deposit in the mining district is broken into many strata; the general drop is 2-3 meters, which has a definite effect on the hydraulic mining process.

The earth layer of the mine has much water, so, there is the difficulty of dripping water when the drifts are made.

II. Mining Method

1. The Mining Method:

The complete operation is a funnel process. The coal recovering method is from top to bottom and from far to near. At the various stages of coal recovering, the working can be done either in the retreating or advancing manner.

2. Elements of the Mining Method:

The width of the coal pillars is generally 10 meters. The distance between the working areas or stopes is 12-15 meters. If the coal quality is relatively better, the distance may be greater. In recovering coal from each stope, the working unit may recover only half of the pillar. The angle in recovering the coal pillars must be properly made to suit the easy flow of water. Generally, the angle is 30°. For the sake of safety, when two units are working in a stope, the working distance varies from 2-3 meters depending on the firmness of the roof. So, a jet of water is turned on, the distance must be 5 meters. When blastings are made, the distance between two stopes must be 10 meters, for safety's sake and to avoid human injuries and troubles from the roof.

3. The Plan for the Making of Drifts and the Method of Constructing Frames for the Nozzles:

(1) The plan for the making of drifts:

There are two types of drifts or levels, namely, wide level and narrow level. The measurements for the cutting of wide levels are: width 3.6 meters, height 1.8 meters. The cutting of a wide level is a combination of making new sluices, embattlements and cutting coal. This hastens the whole mining process. It also employs natural pressure to loosen the hard coal, so that the consumption

of caps and explosives will be lower, while production will be increased, but this can be done only when geological conditions permit.

The measurements for the cutting of narrow levels are: width 2.1 meters, height 1.8 meters. These are used when the geological conditions are: soft coal, high pressure, relatively bad roof, etc.

(2) The method of constructing frames for the nozzles:

There are two methods for the construction of frames and two types of frames, single and double. The former is used when pressure is low and the roof is good, while the latter is used when the roof is broken and pressure is higher. In addition, there are advanced single and advanced double frames, the use of which is also dependent upon geological conditions.

4. The Method for the Making of Sluices and Embattlements:

After the nozzle is moved and before work starts, the embattlement is built to the height of 1.5-2 meters, and the width, half of that of the coal pillars, then the recovering work should begin.

(1) The method of cutting sluices:

Consider the conditions of the coal, then, decide where the blasting should be made. Generally, when a sluice is made, the first blast should have 2-3 holes, the second blast 3-4 holes and the third blast 4-5 holes.

In cutting sluices, the holes for the first blast must be straight (as the holes are straight for recovering coal), and with the exception of the first blast, in all the other blasts, the holes must be made with long drills so that the explosives can be dropped deep into the coal. This method is a combination of deep and shallow holes.

(2) The method of cutting coal:

The cutting of coal should be done from the inside to the outside, from far to near. Get the coal at the bottom first, then finally pick the coal from the top. The jet of water from the nozzle must be moved constantly so as to create an even stream on the coal and let the high pressure water and the stream of water

with the coal be separated. Thus, the processing of coal is evenly done and the use of water is reasonable.

5. The Organization of a Working Force and the Control of Roof Timber:

(1) The organization of a working force:

Each shift of workers should have 3 groups of men to cut coal, 3 groups to make sluices, 3 groups to move the nozzles. Each group should have one attendant for the nozzle, one assistant, two men to look after the operation of the electrical equipment. In each shift of workers, there should be two men to take charge of the explosives, one man to attend the sieve and one man to regulate the use of all machines.

(2) The recovery of timber from posts and the control of roof timber:

About 80% of the timber used as posts can be recovered. By using the nozzle or a collecting tractor, the timber used to support the roof can be recovered. After all coal has been recovered, the roof timbers generally come down by themselves.

NO. 54 COAL PRODUCTION TEAM ADVANCES 164 METERS PER MONTH IN RECOVERY TECHNIQUES

[The following is a translation of an article by the Tzu-po Mining Bureau, Hung-shan Mine, Mei-k'uang Chi-shu, Peiping, No. 9, 1960, pp 13-15.]

Since the Coal Ministry proclaimed the five great reforms, appealing for a great march toward a high, skillful and peak production, the No. 54 Coal Production Team, well known for its efficient recovery techniques, has led the movement well ahead with the determination to attain the highest peak in coal recovery. Under the able guidance of the Party and the upper levels and with the cooperation of all mine workers and staff, the Team has decided to make use of every minute and second of time and to cover every inch of earth in the mine in carrying out its efficient 24-hour non-stop operation of deep-cutting and multiple-stage coal recovery methods.

The coal seam is one meter thick and has an 80-meter long-wall machine-cutting working face. Under these conditions, the Team is able to attain the highest speed of progress at 8.4 meters a day, with a daily output of 814 [metric] tons, at the efficiency rate of 11.31 tons/worker (kung). The Team has fulfilled the goal of high speed, high production and high efficiency. In the revolution of rapid recovery techniques and the advancement of goals, the Team has broken through and is now getting results, but it is still striving for greater successes.

The multiple-stage non-stop coal recovery method, used by the No. 54 Coal Production Team, although it is just at its beginning stage, has obviously shown that it has found a new road for the present development of rapid recovery techniques at a machine-cutting working face. This is a new advancement achieved by the four-eight cross-cut operation basis. The characteristics of the new

form of technical organization are:

Firstly, the whole 24 hours in a day are being used for the recovery of coal, so the maintenance and repair of machinery are being done while the operation of recovering coal is carried out. This has altered the general practice of "recovering coal--maintenance and repair--recovering coal--maintenance and repair". This method has permitted the whole 24 hours to be devoted to recovering coal.

Under the single stage or two-stage methods, there are only 16 hours for recovering coal, and 8 hours for maintenance and repair. Under a three-stage method, the coal recovery time is increased to 21 hours and 3 hours for maintenance and repair. But now, with the four-stage method, all 24 hours are used for coal recovery; thus, this method has made full use of the space and time available for any given working face.

Secondly, because there are conditions suitable for the non-stop operation of coal recovery, the Team made a brave attempt to introduce the three-stage method to supersede the single-stage and two-stage methods at first, and finally, it has made use of the four-stage method. The increased number of phases is the main reason for the higher speed and higher production.

Thirdly, the Team has used long-blade cutters, making cuts as deep as 2.4-2.8 meters. In order to attain a cutting area of 780 square meters for each day's work, the Team has used two machine cutters. This is a skillful coordination of production speed and mechanical efficiency.

Fourthly, in order to fulfill its rapid production goal, the No. 54 Coal Production Team has made used of the advanced experiences that have been attained by the other mining areas, including simplified loading methods, double electric conveyors, metal pillars, etc. These have helped the Team to develop its new recovery technique.

Fifthly, the Team's four-eight cross-cut operation is a plan applied for the allocation of the miners' working time. Under this plan, each miner is nominally working in the mine for 8 hours a day, but actually he works only 6 hours, while the other 2 hours are used in making preparations for work, his coming into the mine from the outside, and his leaving the working area and departure from the mine. Compared with the old working schedule, the miners are working in the mine ½ hour less than previously. This enables the miners' time to be used

effectively while they are in the mine and at the same time it has increased their rest time. In the off-hours, the miners have more time for meetings, education, and cultural entertainment. This is a leap forward for the development of ideas, technical production, cultural learning and the training of skilled labor.

The following is a list of important factors involved in the deep-cutting, multiple-stage, non-stop coal recovery method:

I. Working Face Arrangement and Geological Factors

The No. 54 Coal Production Team is now working in the 5070 Mining District (Ts'ai Ch'u) of the Hung-shan Mine. The thickness of the coal deposit is about 0.9-1.0 meter, in the middle of which, there is a layer of stone about 0.1 meter thick. The quality of coal is medium hard, containing nut-like sulfurized iron. The coal has a 5-9 degree inclination. The direct roof is a thin layer of limestone, which is 0.6 meter thick, and on top of this, there is a 4-6 meters thick layer of rocks. The surface is sandstone, and the floor is also sandstone.

At the working face, the long-wall method of coal recovery is used. The wall is 60-80 meters long. In order to preserve a level for transportation, a 10-20 meters coal pillar is made at the lower end of the working face. Therefore, transportation from the various points of the working face must come over the tracks made by the electric conveyor to reach the main transportation level. On the main level, an electric railway is constructed to haul the coal to the outside.

Ventilation is from the bottom up, and fresh air is brought in through the safety tunnel.

The roof timbers are controlled by the partial-caving method. The working face has four conveying belts. Between the belts, there are two rows of posts, one in double posts in pairs, and one in single posts. The distance between them is 1.2-1.4 meters, and the slope is one meter.

The mechanical equipment of the working face are: two 63-horsepower coal cutting machines, that can cut 2.4-2.8 meters in depth; 2 scraping electric conveyors, one small and one large conveyor, the former is 20 meters

long and the latter 80 meters long; the two conveyors are placed in parallel positions.

II. Stages and Labor Organization in the Daily Four-Stage Operation

The No. 54 Team divides the whole day into 4 phases, each of which has 6 hours. Each stage comprises the whole variety of activities that are necessary for the production of coal, such as: cutting, moving, loading and transporting the coal, erecting pillars, operating the electric conveyors, filling excavations, and recovering timber. These activities are combined into 3 groups, as: coal recovery and the recovering of timber, transportation and operation of the electric conveyors, and drilling for blasting and the filling of holes, These activities are done simultaneously.

The form of organization for each circulation is based on the four-eight cross-cut operation of the four working shifts, each of which has an eight-hour working schedule. That is to say, the cross-cutting or overlapping time between two shifts of miners starts when one group of miners goes into the mine to take over the work and it ends when the out-going group of miners has left the mine. Thus, the time used by the miners in coming and leaving, in making preparations for and the ending of their tasks, is consumed in the cross-cutting time, which does not affect the actual 6 hours of working time. Every miner actually puts in 6 hours of effective coal recovering time, not a minute has been lost in production.

Each shift of miners is organized on a similar basis, into several groups, each of which is assigned a special task. Each shift has 36 miners (3 car tippers (tao-ch'e) are not included in working face efficiency), with the total number of miners for the four shifts as 144 miners. The assignment of tasks and the number of miners to each group are as follows:

Coal cutting and erecting pillars	6x4 - 24 miners
Loading coal and moving conveyors	10x4 - 40 miners
Erecting posts and recovering timber	4 x4 - 16 miners
Boring holes and filling hollows	8x4 - 32 miners

Transportation of coal	3x4	- 12 miners
Operating the shovels	5x4	- 20 miners
Total	36x4	- 144 miners

In addition, there are several workers added to each shift of miners, such as: one man for the electric drill, one man for the discharging of explosives (3 shifts a day), and two foremen to each shift, in charge of production and the recovering of timber.

III. Two Electric Conveyors Working Alternately Permits Production on a Non-Stop Basis

Before two conveyors are used, though the time used to move the conveyor may be reduced to 60 minutes, the time used in making necessary preparations before moving and the time consumed in waiting after the moving in completed constitute a suspension of production. The greater the number of stages, the greater the suspension of production will become. For instance, if there were four phases in a day, the time wasted in moving the conveyor will amount to 4 hours.

The No. 54 Team, in using two electric conveyors, aims to overcome the aforementioned difficulty. While the small conveyor is in operation, the large one is moved, and when the large conveyor is in operation, the small one is moved. The two are used alternately; thus, it has become a 24-hour non-stop operation.

The small conveyor is a 20 meter-long SKR-11 [transliterated from Cyrillic] model. Its electric drive and brake are on the side close to the coal wall. The end is 0.8 meter long and of light construction. The two conveyors are placed in a parallel position, with a row of single posts in between. On the trail of the machine cutter, another hollow should be cut in the coal just ahead of the length of the small conveyor, so that the conveyor can be easily moved for the next stage. The small conveyor should not be too short nor should it be too long. When the large conveyor is moved and ready, the small conveyor should have finished its task, waiting for the second machine cutter to finish and discharge coal onto the middle; then it is time for the large conveyor to be moved.

After the cutting of the lower 40 meters of coal is completed, the first machine cutter should discharge its coal. One hour before the shift is changed, the coal should be discharged. When the small conveyor is moved, it should not wait for the large conveyor but should begin to make sluices for 5 meters and then stop. When the large converyor has moved ahead, coal cutting should be resumed again.

As the coal recovery operation progresses, the roof space increasee. Because the roof is a layer of relatively hard rock and because two 5-meter wide converted columns of broken stones have been built, the roof has never had any cave-ins.

IV. Two Machine Coal Cutters Operating in Different Sections and Easy Coal Loading While Cutting

At the present 80-meter working face, the daily four-stage operation should attain a 320-meter of 748-cubic-meter advance. Because one machine coal cutter cannot make such an achievement, the No. 54 Team uses two machine cutters, one at the lower end, cutting 37 meters, while the other at the upper section, cuts 43 meters. When the upper machine cutter cuts deep into the coal wall, the lower machine comes and cuts the points even.

The electric power of the lower machine cutter is supplied from the outside by an [insulated] rubber-wire, which runs along close to the electric conveyor. The attendant of the upper machine cutter must be careful not to damage this wire. Again, when posts or columns are made, it is important that the workers exercise care to prevent the encasing of the wire, rendering the moving of the wire impossible.

In cutting coal, the machine is turned toward and close to the electric conveyor so that the coal dust falls onto the conveyor and is carried away by it. This lessens the load on the cutter. Again, when the coal in the trough of the cutter gets sufficiently heavy, it falls because of its own weight, but as the coal falls it is caught by the chain of the conveyor and is carried away. This, in effect, is an easy coal loading action. It is estimated that in every stage, 25-30% of the coal

has been loaded by the cutters in this manner. This also accelerates coal cutting speed. All in all, the cutting operation in each phase can be done in 3-4 hours, while the rest of the time is used in discharging the coal and doing maintenance and repair work on the machines.

V. Pre-Installation of Two Rows of Paired Close Posts and Building Columns Filled with Broken Stones to Lessen Top Pressure on Roof

This method of roof timber control is merely following that which has been used under the one-stage operation. But now, the SGK-II model metallic pillars are used along with the broken-stone filled-in columns, and so far, roof timbers have shown very little caving, even the speed coal recovery has been increased. According to observations, in the roof span from the coal wall to the close posts, the distance is 7 meters, yet the slight caving of the roof timber is only 20-30 millimeters, whereas, the caving of the roof timber under the one-stage operation has been 80-120 millimeters.

However, the theory that the daily speed of advance of 6 meters would counteract pressure from the top, to relieve roof timbers from caving, has not been conclusive yet. On the other hand, when roof timbers show any caving at all, it means that there is pressure. This pressure is exerted in a cycle, which varies 30-90 meters in accordance with the varying span of the roof. Therefore, further studies and observations are required to attain a thorough understanding of the law that governs the movement of the roof timbers.

VI. Insure Adequate Supply of Cars and Strengthen Machinery Maintenance and Repair

The multiple-stage and non-stop operation of coal recovery require an adequate supply of cars for the transportation of coal. The No. 54 Team has a daily production rate of 814 metric tons. It has broken all production records in the history of coal mining. Transportation by manpower is far too inadequate. In order to permit the entry of locomotives into the main level as far as

possible, power wire for an electric engine is set up. In some parts of passages the height may go as low as 1.8 meters, so the roof of the locomotive is taken off to allow for engine clearance without damaging the power wire. In some cases where the passage is too narrow, posts are taken away and planks are used instead. All these measures help to solve the problem of transportation in narrow passages in mining thin seams of coal.

The locomotive engineers must see to it that no coal cars, either in the mine or outside of it, should be left standing idle; they must be used constantly. At the time of changing shifts, there should be no problem of car supply.

Under 24-hour non-stop operation, a system of alternate maintenance and repair should be established. There must be a full supply of spare parts. Rest must be given to the machines alternately.

Between the two machine coal cutters, maintenance and repair should be given alternately. Due regard must be given to the condition of the coal; adjust the cutting depths of the two machines evenly so that anyone of the two may be taken out for repair while the other keeps on cutting, without affecting the coal recovery operation.

In supplying spare parts, emphasis has been laid on alloy blades for the cutters, alloy drill heads and chains for the conveyors. At the present, this problem has received much attention but no solution has been found.

Proper rest must be given to the machinery and equipment. This means that when a new working face is being prepared, and while machines and equipment are being installed, those machines and equipment in the old working face should be taken out for a complete overhauling job. It is during this time that the machines and equipment are given rest.

Transportation equipment must be properly maintained and repaired. Constant care is required for smooth operation. From now on, activities along this line must be strengthened.

VII. Field Management and Party Leadership Problems in Multiple-Stage Non-Stop Coal Recovery Operation

In order to fulfill the highest production goal of the year, the No. 54 Team must maintain its daily 8.4 meters advance in coal recovery. It must make full use of every minute of time and strive to cover every inch of ground in the mine. The team uses imported and native equipment, and it strives to be self-sufficient. Based on its own experiences from the past, it also derives benefits from the experiences of the others. From the standpoint of technical organization, it applies the four-phase operation method, with each shift of miners having one phase. Each stage must operate at a fixed speed to attain a certain output, with a fixed number of miners and by certain measures. The two foremen have definite responsibilities over the entire operation. Strong encouragement and material supply must be given to the Team so that a high working morale is maintained. These are the main reasons for the Team's recent successes.

In order to make a further advance and to solidify the achievements it has gained so far, the No. 54 Team should do its utmost to attain a higher speed, to fulfill the goals of "three-high", "five-red", and "seven-mechanization". From now on, further steps must be taken to study and improve the methods of roof timber control, to invent a mechanized method of coal digging, to apply electric power in boring holes for blastings, and to erect stones columns.

COAL DRESSING PLANT ACHIEVES TOTAL AUTOMATION

[The following is a translation of an article by the Pei-piao Mining Bureau, T'ai-chi Mine Coal Dressing Plant, Mei-k'uang Chi-shu, Peiping, No. 9, 1960, pp 19-21 and 35.]

Under the guidance of the general line and the red banner ideology of Mao Tse-tung, with the encouragement of the great advances made in the coal industry, and especially from the appeal made by the Coal Ministry of the Central Government for a "three-mechanization" movement, all the staff members and workers in the T'ai-chi Mine Coal Dressing Plant, in accordance with the Communist spirit of dare to think and dare to act, using native or foreign equipment, and combined with the direct leadership of the plant Party Committee, have bravely struggled for 30 days, and have surmounted many technical difficutlies, then, finally, on 14 March, the coal dressing plant was acclaimed on the basis of its total automation. These achievements have become excellent factors from which a better and greater leap forward may be attained in 1960.

After 30 days of intensive struggle, the staff members and workers of the plant have successfully created the following devices: a non-powered automatic valve for the sorting machine to let coal pass through, a self-operating float line, a mechanized process to substitute for manual sorting of large pieces of coal, automatic loading cars, remote control of electric switches, conveyor-belts, the installation of safety and warning signals on the trough raising machine,acoal bin storage gauges, a simplified low current protection fuse, etc. All in all there are 27 items of important inventions and reforms. Many individual machines have become

automatic and they are linked together under one central control. Thus, the 178 machines in the plant have become a unified entity, rendering total automation in the whole plant.

In the following, a summary of the experiences gained by the T'ai-chi Coal Dressing Plant from its major inventions and reforms through a "three-mechanization" movement is presented, so that other units in the coal industry may derive benefits.

General Explanation

The T'ai-chi Mine is a huge mechanized coal dressing plant. It has an annual processing capacity of nearly two million tons of coal. In its complete processing procedure, the manual sorting of the large pieces of coal occupied 24.1% of the entire operation. In addition, the technical inspection and the maintenance and repair activities were still done by manual labor, which also constitute a very important portion of the plant's operation. Therefore, the goal to raise the level of mechanization for the plant is very obvious.

In the first stage of the "three-mechanization" movement, the spearhead was pointed toward machine improvements. At first, consideration was given to existing conditions and then to the application of simple methods for reducing the amount of manual work. This plant used the experience gained by the Kuan-shan Coal Dressing Plant and enlarge the size of the mesh to 80 millimeters so that larger pieces of coal could go through; thus, this greatly reduced the amount of manual labor. In two days, the mesh of the two sieve machines was enlarged from 50 to 100 millimeters. As a result, two-thirds of manual labor has been saved. The original 78 sorting workers have been reduced to 28. About 64% of the original workers have been relieved. This has solved one of the oldest problem.

At the same time, a mechanic, Comrade Chang Han-min, has successfully completed the T'ai-chi-I model automatic sampling machine and the shaker ball-grinding machine. These also help to reduce manual labor.

In the technical reform movement, workers in the machine tool manufacturing department have successfully created a number of native tools, such as: native lathes,

native planers, and native saws, etc. These not only reduced manual labor but also increased efficiency, and created a material basis for automation.

In the first ten days of the struggle for mechanization, there was an obvious advance toward automation. This took the form of a self-operating float line and the combination of 4 lines.

Under these circumstances, the plant Party branch committee, under instructions from the Party committee of the mining district, outlined to all workers in the plant their task for automation.

However, how was total automation in the coal dressing plant accomplished? At first, all workers and technicians had no idea in their mind. The Party committee in the plant called the workers, the technicians and the cadres together for a meeting and aroused the massee to find out the problem and to propose the theme. After discussion, it was decided that all the machines in the plant could be classified into several categories, all of which could be transformed into automatic machines. It was from not-being to being that the plan for total automation was adopted. With a plan and with a theme, the masses knew what the goal of their struggle was, so their morale was high.

Under the Party's guidance and the masses' collective thinking, 27 important problems were surmounted in 8 days. As of 14 March, 137 reforms have been completed, so that the plant has basically realized total automation. The principal reforms are:

(1) The coal dressing machine has become an automatic sorting machine. The medium-sized coal section of the principal coal dressing machine and the redressing machine both use the non-powered automatic valve;

(2) From the vacuum foam-resisting device to the coal mud pump, to the filter machine and the convey-belt, all these form a self-operating line;

(3) The troughs on the convey-belt are installed with damage warning signals, stop conveyor signals, reverse operation prevention valves, cleaning devices, and low current protection fuses;

(4) The trough raising machine has been reconstructed with connected shafts, and installed with

damage warning signals, reverse operation prevention valves, and low current protection fuses;

(5) All pumps are equipped with electric powered valves, which are centrally and remote controlled;

(6) It has created automatic loading cars and automatic storage facilities;

(7) In the coal bins, gauges are installed to indicate the amount of coal being stored, and the signal light in the gauge can be seen at a distance;

(8) All machines in the plant wre connected and they run together (except a few large machines that are run separately), and the operation of all machines is divided into four sections, each of which is controlled by a centralized switchboard.

Unified operation of all machines is a necessity to automation. Before automation was introduced, each and every machine required one attendant. Under such conditions, the connected operation of two or more machines does not have much meaning. But, when all machines are unified under one operating system, then a comprehensive system of automation is realized.

I. Automatic Sorting Machine

Non-powered automatic sorting valve: In the operation of the sorting machine, the sorting valve is the part that needs most frequent adjusting. The workers themselves have created the non-powered automatic sorting valve, which requires no manual attention at all. The valve is operated by the fluctuations of the machine table.

In the process of developing this valve, the workers made use of the same principle and created the reclining automatic valve. A wooden floating valve, wrapped with a rubber belt, is used instead of the original vacuum iron box. This simplifies the entire machanism of the valve. Its construction requires less material and can be installed more easily.

The operating principle of the reclining automatic sorting valve (Figure 1): Set the wooden floating

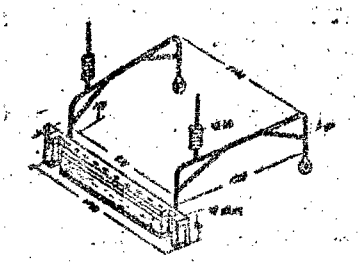

Fig. 1 Principle of the Automatic Sorting Valve

valve, which is wrapped in a rubber belt, onto the natural level (of the medium-sized coal or the cinnabar stones). When the machine is in motion, its table moves up and down, so the floating valve also moves up and down as the machine table does, thereby the products (coal or cinnabar stones) are sorted through and under the valve. The floating valve is supported by a metallic frame, attached to the shaft of the machine, which enables the valve to move as a swing. A weight, which can be increased or reduced, can be attached to the valve to regulate its operation; that is, the amount of coal and the thickness of coal layer on the machine table can be regulated by the weight added to the valve.

The non-powered automatic sorting valve, at the present, cannot be used at the cinnabar section of the principal coal dressing machine because the weight of the cinnabar layer is greater and more compact; its pressure constantly stops the operation of the valve.

In order to make the entire dressing machine automatic, the valve is again transformed into power-operated, so that the problem of sorting cinnabar stones can be solved.

The operating principle of the power-operated sorting valve (Figure 2): It is done through the systematic organization of the float, the valve and the switch. The valve is connected to the switch by a lever, while the float is used to indicate the thickness

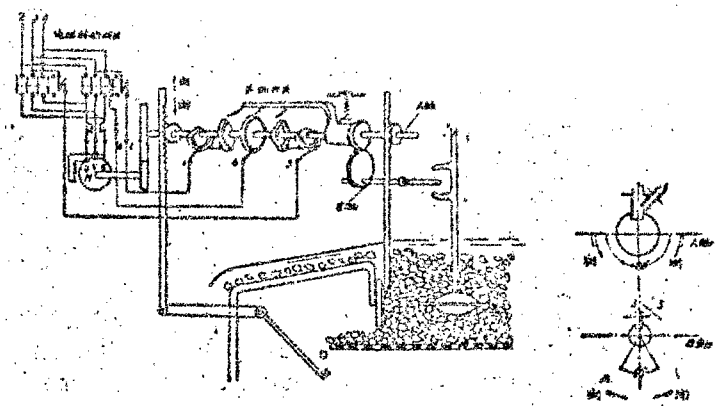

Fig. 2 Principle of Power-Operated Sorting Valve

of the natural level (the cinnabar layer or the medium-sized coal layer) and to regulate the switch. When the thickness of the cinnabar layer increases, the float rises, making the B shaft to turn and thereby causing the A shaft to turn downward; at this time, the points 1 and 4 are connected with an electric current; thus, through the lever the valve is opened. Then, when the thickness of the cinnabar layer (or the coal layer) decreases, the float lowers, as such, the points 3 and 4 are connected with an electric current, and through the lever, the valve is closed.

II. Automatic Operation Line in the Float Selection Department

The float selecting machine produces the foam products in the vacuum foam-resisting device. The worker at the filter machine must keep a constant watch on the level of the mineral paste and to notify the attendant at the coal mud pump and the worker at the convey-belt to start or stop the operation as it is required by the rise and fall of the paste level. Therefore, the operation in this department requires three workers to keep it running.

Two electricians, Comrades Kuo Tien-ching and Chao Shih-wu, have successfully connected the foam-resisting device with the coal mud pump and finally connected the convey-belt, so that the operation in this department becomes a unified automatic line. When the mineral paste in the foam-resisting device has risen to a certain level, all the machines in this department begin to operate automatically; when the paste gets too low, the machines stop operation at once. Under these conditions, only one attendant or sometimes no attendant is required for this department.

The operating principle of the self-operating or automatic line: The electrical circuit shows the connections of the various automatic controls in the float selection department (Figure 3). On the wall of the

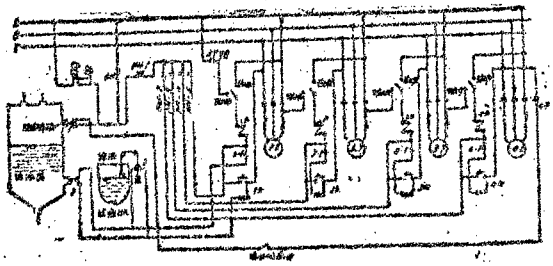

Fig. 3 Principle of Automatic Circuits

foam-resisting device, there are attached two pieces of thin rubber. When the device is filled with paste, the two rubber pieces are forced outward and contact point "1". At this time, the coil of the current connecting mechanism in the centre PH is set in place, so that electric current runs through at points PH-2, PH-3, PH-4, and PH-5, and when the current runs through point PH-1, a few moments later, then the electric powered machine begins to operate.

The reason for the current to run through PH-1 a few moments later than at the other points lies in the fact that during these few moments, a signal is given to the attendant that all preparations must be completed before the operation begins. As soon as the current runs through point PH-1, the four machines all start at the same time.

When the fourth set of equipment in the last machine is in motion, the coil 4 P is charged with power, 4-2 start moving and the signal goes off. When all machines are in motion, the point at 37XQ is connected, and only the cleansed good coal goes into the conveybelt for storage. Each machine is equipped with a switch. When individual operation is desired, it can be attained by turning off the switches of the other machines.

When the coal paste in the foam-resisting device gets below the surface of the lower rubber piece on the wall, the connecting point "2" is off, and the machines stop, enabling the coal mud pump to force the product onto the filter machine for processing. When this is completed, the float descends until it connects point "3", which causes all the machines on the entire line to come to a stop.

III. Automatic Loading Cars

In order to store the dressed coal into the various bins, the transportation cars on the storage conveybelt are so constructed that they can be adjusted to various unloading positions. As the cars run on the tracks, they are mainly operated by a belt and some cylinders. By manipulating the catches attached to the cars, their motions are regulated.

In the process of total automation, the automatic loading operation is the hardest to accomplish. Comrade Liu Ching-hua, with the support of the Party committee in the plant and many other workers, conducted a hard-fought struggle through 8 days and nights and made 8 improvements. Finally he was able to solve this most complicated problem by successfully creating a loading car that could adjust itself to various unloading positions automatically with no need for man control.

IV. Storage Gauge Signal for Coal Bins

The automatic loading cars can be operated without manual control in adjusting itself to various unloading positions, to look for storage space and to load the bins. But, in order to know the exact situation of production at any time and to arrange the freight cars most conveniently under the storage bins, a man must be sent to check the exact amount of coal stored in each bin. So, with the hope of coordinating the operation of the automatic loading cars and to enable the storage keeper to know the exact amount of coal stored in each bin, the workers have made repeated studies and finally succeeded in creating a gauge signal to be installed in each coal bin, which can indicate the exact level of the coal stored therein at any time. (Figure 4)

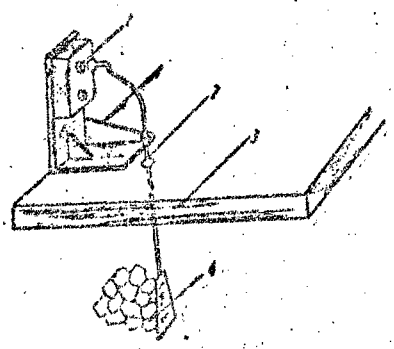

Fig. 4 Storage Gauge Signal

When coal is being loaded into the bin, the coal exerts pressure on a moveable board, which is connected with a lever, that in turn is connected with a gauge signal. The moveable board therefore lights the signal in accordance with the pressure received from the amount of coal being stored in the bin. On the other hand, when coal is discharged from the bin, the pressure on

the moveable board is removed, so the board comes back to its orig nal place; thus, the lever disconnects the gauge signal and the light goes out.

V. Automatic Warning Signal and Automatic Protection Equipment Installed on Convey-Belt

The transportation belt machine is one of the principal means of transportation in the plant. Generally, it is taken care of by workers. When any one of the troughs is broken down, it may cut or break the belt. When the head of the convey-belt is blocked by coal, the belt itself cannot be operated. In the "three-mechanization" movement, the workers have created two systems of automatic warning signals. When any one trough jumps off its track, it presses on the valve on the belt. This section sets off the sound-light warning signal. Again, when the belt is blocked by coal, the weight of the coal on the belt causes the moveable contact points to come together and set off an alarm. (The signal contacting system and the trough raising machine are similar).

Besides, when the convey-belt carries a load of coal up a bank, it frequently stops in the climbing and the coal would fall back and heap on the end of the machine. This interferes with transportation and makes cleaning activities difficult. In order to prevent the troughs from falling back, a safety device has been created. This is done by attaching a slightly curved belt under the main cylinder of the machine. As soon as the belt falls back, this short curved belt is drawn into the cylinder and acts as a brake on the belt.

In order to protect the belt, a device is created to clean the belt by scraping off the coal falling on it from the troughs and to prevent the belt from running off its track. When the belt is carrying wet materials, bits often drop on the belt and the accumulation of these bits frequently causes trouble to the smooth running of the belt. So, a rubber wheel is attached to the head of the returning empty belt. This wheel is connected to the big shaft of the machine by a belt and it slightly touches the surface of the belt. As the belt comes along, the rotation of this

wheel scrapes off all accumulat J materials from the surface of the belt.

VI. Automatic Warning Signal of the Trough Raising Machine

In the technological system of the coal dressing plant, the trough raising machine is the machine that has the most troubles. It needs the most constant care and inspection. The frequent spillings from the troughs and the jumping off from tracks by the troughs generally cause accidents to the machine, which may mean the stopping of production. In the process of automation, steps must be taken to prevent all these complicated difficulties.

The installation of automatic warning signals to the trough raising machine (Figure 5), in accordance

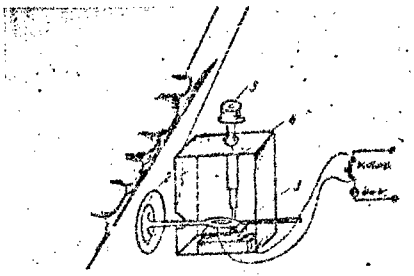

Fig. 5 Installation of Trough Raising Machine Automatic Warning Signals

with the different nature of the various types of accidents, requires the setting up of three open switches at different positions along the line of the troughs, so when any difficulty such as off track, spilling, or the breaking of a trough at its joints, would happen, it immediately sets off a sound-light signal alarm. In order to

prevent spillings, the direction of the shafts of the troughs has been altered and the length of the shafts is made longer.

In order to centralize control, a guiding board is established at a focal point. On this board, electric bulbs and bells are used to show the operation of the various equipments. The occurrence of different accidents is represented by different colored lights and by the different tones of the bells. The bulbs and bells are connected so that they act together.

In addition, when the machine stops, there is a device installed to prevent the troughs from sliding backward forced by the weight of the materials they are carrying.

VII. Automatic Water Gate

The plant uses water to dress the coal. Consequently, there are many water pumps in the plant. Previously, these pumps need many workers to attend and operate them. Now, a centralized remote control system is established, and the pumps are power operated (Figure 6).

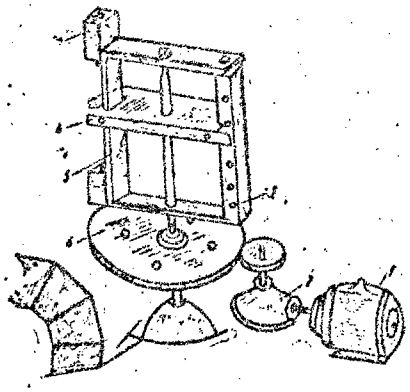

Fig. 6 Automatic Water Gate

In the construction of an automatic water gate, the regulating wheel (4) is changed into a depressed wheel and a 0.9 kilowatt decelerating electric motor (1)

is used to move the lever (5), which opens or closes the gate; thus, no man is needed for this operation. When it is turning in the other direction, a different method of connecting the current is used. The copper tacks (3) on the frame of the lever are used to connect the electric currents to open the gate, which is indicated by signal lights. The operating switches on top and bottom of the frame are used to stop the gate automatically when it is opened or closed.

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